Answer on Question#39291 – Math - Other

If a train leaves station A, take 2ms squared to get to 36ms then travels for 90 seconds and then decelerates at 3ms squared to stop at station B. What was the total distance traveled? How long did it take the train from station A to station B?

Solution:

Assumption: to find the total traveled distance we can break all path up into three phases: accelerating $\rightarrow$ moving with constant speed $\rightarrow$ decelerating.

First phase (accelerating)

Rate equation for the acceleration phase:

$$V_1 = a_1 t_1$$

$$t_1 = \frac{V_1}{a_1} = \frac{36\frac{\text{m}}{\text{s}}}{2\frac{\text{m}}{\text{s}^2}} = 18\ \text{s}$$

It means that accelerating will stop after 18 seconds because then the train will reach velocity $36\frac{\text{m}}{\text{s}}$.
Equation of motion for the acceleration phase:

$$S_1 = \frac{a_1 {t_1}^2}{2} = \frac{2\frac{\text{m}}{\text{s}^2}\cdot(18\text{s})^2}{2} = 324\ \text{m}$$

Second phase (moving with constant speed):
Train travels path at $36\frac{\text{m}}{\text{s}}$ for 90 s:

$$S_2 = V_2 t_2 = 36\frac{\text{m}}{\text{s}}\cdot 90\text{s} = 3240\ \text{m}$$

Third phase (decelerating):
Rate equation for the decelerating phase:

$$0 = V_2 - a_3 t_3$$

$$t_3 = \frac{V_2}{a_3} = \frac{36\frac{\text{m}}{\text{s}}}{3\frac{\text{m}}{\text{s}^2}\ \text{s}} = 12\ \text{s}$$

Equation of motion for the deceleration phase:

$$S_3 = \frac{a_3 {t_3}^2}{2} = \frac{3\ \frac{\text{m}}{\text{s}^2}\cdot(12\ \text{s})^2}{2} = 216\ \text{m}$$

$$\text{all distance } S = S_1 + S_2 + S_3 = 324\ \text{m} + 3240\ \text{m} + 216\ \text{m} = 3780\text{m}$$
$$Time\ of\ the\ travel\ is\ T = t_1 + t_2 + t_3 = 18\text{s} + 90\text{s} + 12\text{s} = 120\text{s}.$$

Answer: train was in motion during 120s and has traveled distance 3780m.